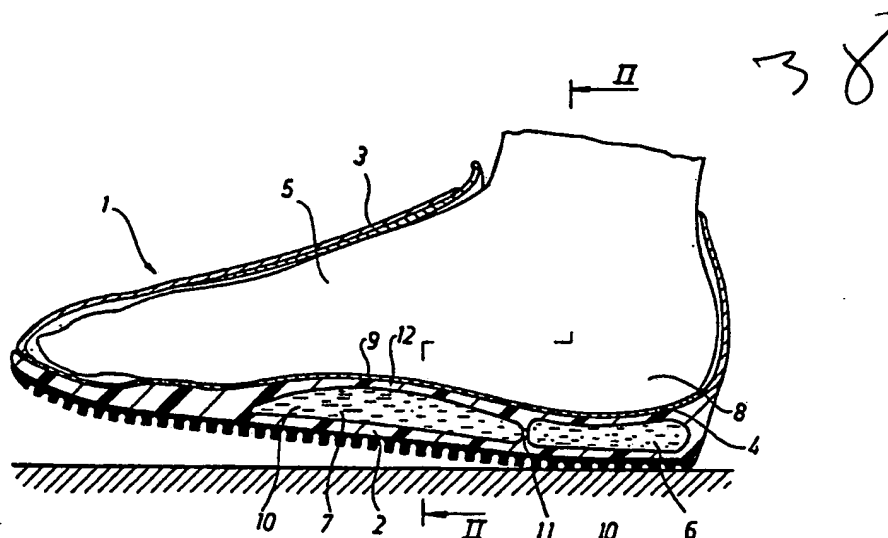




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : A43B 13/18 // A61F 5/14	A1	(11) International Publication Number: WO 93/18677 (43) International Publication Date: 30 September 1993 (30.09.93)
(21) International Application Number: PCT/SE93/00239 (22) International Filing Date: 23 March 1993 (23.03.93) (30) Priority data: 9200881-2 23 March 1992 (23.03.92) SE (71) Applicant (for all designated States except US): SPORT-TRAUMA AB [SE/SE]; Solnedgängen 32, S-433 34 Partille (SE). (72) Inventor; and (75) Inventor/Applicant (for US only) : PETERSON, Lars [SE/SE]; Solnedgängen 32, S-433 34 Partille (SE). (74) Agent: AWAPATENT AB; Box 11394, S-404 28 Göteborg (SE).		(81) Designated States: AU, CA, JP, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>

(54) Title: SHOE SOLE CONSTRUCTION**(57) Abstract**

In a shoe sole (2) comprising a first chamber (6) and a second chamber (7), which chambers are completely or partially filled with a fluid (10), and a channel (11) interconnecting said chambers (6, 7), by means of which channel the fluid (10) upon compression of one of the chambers (6 or 7) may be transferred to the other one of said chambers to expand said other chamber, the first chamber (6) is positioned so as to extend essentially only underneath the heel portion (8) of the foot (5) whereas the second chamber (7) is positioned so as to extend essentially only underneath the longitudinal arch (9) of the foot (5). Upon expansion of the second chamber (7) due to the compression of the first chamber (6) when affected by the heel portion (8), said second chamber forms a dynamic pronation support underneath the longitudinal arch (9). When this arch bears a weight thereon, it causes the second chamber (7) to be compressed.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	MR	Mauritania
AU	Australia	GA	Gabon	MW	Malawi
BB	Barbados	GB	United Kingdom	NL	Netherlands
BE	Belgium	GN	Guinea	NO	Norway
BF	Burkina Faso	GR	Greece	NZ	New Zealand
BG	Bulgaria	HU	Hungary	PL	Poland
BJ	Benin	IE	Ireland	PT	Portugal
BR	Brazil	IT	Italy	RO	Romania
CA	Canada	JP	Japan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SK	Slovak Republic
CI	Côte d'Ivoire	LI	Liechtenstein	SN	Senegal
CM	Cameroon	LK	Sri Lanka	SU	Soviet Union
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	MC	Monaco	TG	Togo
DE	Germany	MG	Madagascar	UA	Ukraine
DK	Denmark	ML	Mali	US	United States of America
ES	Spain	MN	Mongolia	VN	Viet Nam
FI	Finland				

SHOE SOLE CONSTRUCTION

The present invention generally concerns a shoe sole having a dynamically shock-absorbing structure, but above all a shoe sole providing a dynamic pronation support. The shoe sole is particularly suitable for sport shoes and may be used for instance for running on hard surfaces. It may also be used in e.g. walking boots, working shoes, in principle in all types of footgear. It may also be designed as a separate insole to be placed inside the shoe it is designed for.

In walking and running, the foot has to bear considerable weight corresponding to several times the body weight, each time it is set down into contact with the ground or the surface underneath. The cushion of fat found for instance in the heel dampens the impact upon heel strikes, that is the phase of the walking cycle when the heel is set down into contact with the surface underfoot. At the midstance stage of the walking cycle, when the whole foot is in contact with the surface, and at the heel elevation stage, when the heel portion is lifted, the main weight is on the longitudinal arch of the foot (the arch extending lengthwise on the inner side of the foot), resulting in deformation of this arch which plays an important part of the energy absorption.

During walking and running the feet pronate, i.e. the outwards margin of the foot is turned outwards-upwards as the foot is set down on the ground or the support. An increase of the pronation results in an increase of the weight on the longitudinal arch of the foot and consequently a higher risk of overstraining, which in turn may be the cause of permanent deformation of the arch.

Congenital anatomic conditions, such as an increased pronation or other weaknesses in the foot, cause degradation or weakening of the various functions of the foot which may give rise to insufficiency symptoms originating from the longitudinal arch. The problems caused by

weakened longitudinal arches may often be remedied by the use of suitable arch supports. Also originally normal longitudinal arches may, when exposed repeatedly to heavy loads from walking or running on very hard surfaces, may
5 lose their vaulted shape and consequently their weight-distributing capacity, which could also produce insufficiency symptoms.

Problems of this kind are common and are caused for instance by the use of unsuitable or bad-fitting shoes, or
10 e.g. by activities carried out on hard surfaces, such as asphalt and concrete. Preventive as well as therapeutic measures to avoid such insufficiency conditions therefore are most important. Malfunctioning of the feet and unsuitable or badly constructed shoes may also cause injuries
15 and lead to insufficiency conditions, particularly in the lower extremities, such as the feet, the ankle joints, the lower leg, the knee joints, the hip region and the back.

Sport activities expose the body to considerable stress and strain. Particularly during sports activities
20 such as running, jumping, and the like, large parts of the skeleton must bear considerable weight, a condition which is aggravated for instance by excess pronation, and which may lead to injuries on the lower extremities and in the back. Such injuries may occur as a result of long-standing
25 and repeated weight bearing, as is the case with for instance long-distance runners, or may be caused by isolated instances of heavy but unsuitable exposures to weight bearing, such as may be experienced e.g. in triple jumping.

30 Shoes for sport uses therefore should have a sole which is able to absorb and cushion as far as possible the shocks and the load produced as the foot is set down into contact with the ground. However, the shoe sole must not be too thick, as this would make the shoe too heavy and
35 thus impair the achievable results of the contestant.

The purpose of the present invention thus is to provide a shoe sole of a construction that is capable of providing satisfactory shock absorption while at the same time giving the longitudinal arch of the foot a dynamic
5 pronation support.

To achieve this purpose, the shoe sole in accordance with the invention is formed with a first chamber and a second chamber arranged in the sole and completely or partially filled with a fluid, and with a channel inter-
10 connecting said chambers, said channel arranged, upon compression of one of the chambers, e.g. the first chamber, to transmit fluid from said first compressed chamber to the second one of said chambers for expansion of said second chamber, or vice versa, said first chamber
15 being positioned essentially only underneath the heel portion of the foot. The characteristic features of the invention are that the second chamber is positioned essentially only underneath the longitudinal arch of the foot and in that due to the compression of the first
20 chamber when the latter is activated by the heel portion, said second chamber fills with fluid and expands, lifting the longitudinal arch immediately prior to said arch absorbing the load and thereafter being deformed. In this manner the arch of the foot receives a dynamic support
25 during the deformation which is gradually dampened.

By means of a shoe sole constructed in this manner excellent shock absorption is achieved as the heel portion is set down on the support while at the same time the person wearing the shoe enjoys a dynamic pronation support
30 at midstance, i.e. when the entire foot is in contact with the ground. A shoe sole of this construction considerably reduces the risks for injuries on and insufficiency conditions arising from above all the longitudinal arch of the foot and the lower extremities while at the same time
35 it facilitates sports activities, such as running, jumping and similar sports.

4

The invention will be described in closer detail in the following with reference to the accompanying drawings illustrating an embodiment thereof which is preferred at the moment, and wherein

5 Fig. 1 schematically in a longitudinal section view illustrates a shoe fitted with a sole in accordance with the invention in the heel-strike phase of walking or running, i.e. when the heel portion is set down into contact with the ground.

10 Fig. 2 is a cross-sectional view along line II-II of Fig. 1.

 Fig. 3 is a view similar to Fig. 1 but illustrates the heel elevation phase of the cycle, i.e. when the rest of the foot is set down into contact with the ground but
15 the heel portion is lifted.

 Fig. 4 illustrates schematically in a perspective view obliquely from above the shoe sole in accordance with Figs. 1 and 3, showing in closer detail the position of the chambers formed in the sole.

20 The shoe sole illustrated in the drawing figures indicated generally by reference 1, comprises a sole 2 to be described in closer detail in the following, uppers 3 and an insole 4. The shoe is shown worn on a foot 5.

 As appears from the drawing figures, the sole is
25 formed with a first chamber 6 and a second chamber 7, the first one of which, 6, being positioned essentially only underneath the heel portion 8 of the foot 5 whereas the second chamber 7 is positioned essentially only underneath the longitudinal arch 9 of the foot 5.

30 The first and the second chambers, 6 and 7, respectively, are completely or partially filled with a suitable fluid 10, such as a gas and a more or less viscous liquid. The chambers 6 and 7 are interconnected by means of an interconnection channel 11 which is arranged in the
35 interior of the sole 2 and which may be formed by two or several branch channels.

Via the interconnection channel 11 the fluid 10 may be transferred from one channel to the other, i.e. upon compression of chamber 6 it is transferred to chamber 7 to expand the latter, and reversely. Upon expansion of the second chamber 7 due to the compression of the first chamber 6 as the latter is affected by the heel portion 8 of the foot 5, the second chamber 7 acts as a dynamic pronation support underneath the longitudinal foot arch 9, whereby, when the latter is exposed to load as a result of the foot hitting the ground, said second chamber 7 will be compressed followed by expansion of the first chamber 6 via the interconnection channel 11.

As appears particularly from Figs. 1, 2 and 4, the second chamber 7, in its expanded condition, will impart to the portion 12 of the sole 2 that is contiguous with the longitudinal arch 9 a configuration conforming to the natural shape of the longitudinal arch 9 of the foot in the non weight-bearing condition of the arch.

In order to produce a controlled and/or predetermined throttling of the flow of the fluid 10 between the chambers 6 and 7 via the interconnection channel 11, the latter may be formed in one or several of the branches thereof with a throttling means, not shown, e.g. in the shape of a constriction of the channel and/or an adjustable throttling valve.

For the purpose of supplying or removing fluid 10 and thus of adapting the dynamic pronation support at will and according to need an external connection fitting, not shown, may be provided for at least one of the chambers 6, 7 and/or for the interconnection channel 11. The external fitting could comprise a non-return valve or similar means in the edge portion of the sole 2, said non-return valve being connected to the associated one of chambers 6, 7 and/or to the interconnection channel 11 via a connecting passageway.

6

Like the interconnection channel 11 which as mentioned previously may be formed from two or several part or branch channels also the first and/or the second chambers 6 and 7, respectively, could of course be divided
5 into two or several part chambers to vary the qualities of the shoe 1 or of the sole 2. For instance, the sole 2 may thus be made more or less resilient and its shock-absorbing and supporting effect be made larger or smaller.

The invention should of course not be regarded as
10 limited to the embodiment illustrated in the drawings and referred to in the foregoing but may be modified in a variety of ways within the scope of the appended claims.

15

20

25

30

35

CLAIMS

1. A shoe sole comprising a first chamber and a second chamber (6 and 7, respectively), said chambers arranged in said sole and completely or partially filled with a fluid (10), and a channel (11) interconnecting said chambers (6, 7), through which interconnecting channel (11), upon compression of said first chamber (6), fluid (10) may be transmitted from said first chamber (6) to the second one (7) of said chambers for expansion of said second chamber (7), or reversely, said first chamber (6) being positioned essentially only underneath the heel portion (8) of the foot (5), c h a r a c t e r i z e d in that the second chamber (7) is positioned essentially only underneath the longitudinal arch (9) of the foot (5) and in that due to the compression of the first chamber (6) when the latter is affected by the heel portion (8), said second chamber (7) fills with fluid (10) and expands so as to lift the longitudinal arch (9) immediately before said arch (9) is about to absorb the load which arch is then deformed, whereby said longitudinal arch (9) receives a dynamic support during the deformation which is gradually dampened.

2. A shoe sole as claimed in claim 1, c h a r a c t e r i z e d in that in its expanded condition the second chamber (7) imparts to the portion (12) of the sole (2) that is contiguous with the longitudinal arch (9) a configuration conforming to the natural shape of the longitudinal arch (9) of the foot in the non weight-bearing condition of said arch.

3. A shoe sole as claimed in claim 1 or 2, c h a r a c t e r i z e d in that the interconnecting channel (11) comprises a throttling means for controlled and/or predetermined throttling of the flow of the fluid (10) between the chambers (6, 7).

4. A shoe sole as claimed in any one of the preceding claims, c h a r a c t e r i z e d in that at least one of the chambers (6, 7) or the interconnecting

8

channel (11) is provided with an external connection fitting for supply or removal of fluid (10) and thus adaption of the dynamic pronation support according to will and according to wish.

5 5. A shoe sole as claimed in claim 4, c h a r a c -
t e r i z e d in that said external connection fitting is
formed with a non-return valve in the edge portion of the
sole (2), said non-return valve connected to the
associated one of the chambers (6, 7) and/or to the inter-
10 connecting channel (11) via a connecting passageway.

6. A shoe sole as claimed in any one of the pre-
ceding claims, c h a r a c t e r i z e d in that the
first and/or the second chamber (6, 7) is/are divided into
two or several part chambers.

15 7. A shoe sole as claimed in any one of the pre-
ceding claims, c h a r a c t e r i z e d in that the
interconnection channel (11) is arranged in the interior
of the sole (2) and is formed by two or several part
channels.

20

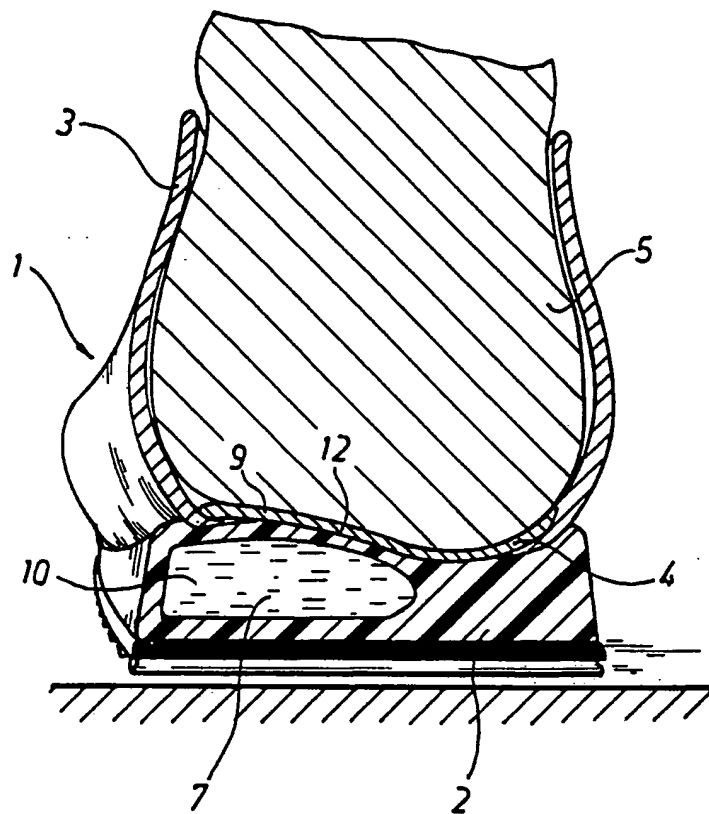
25

30

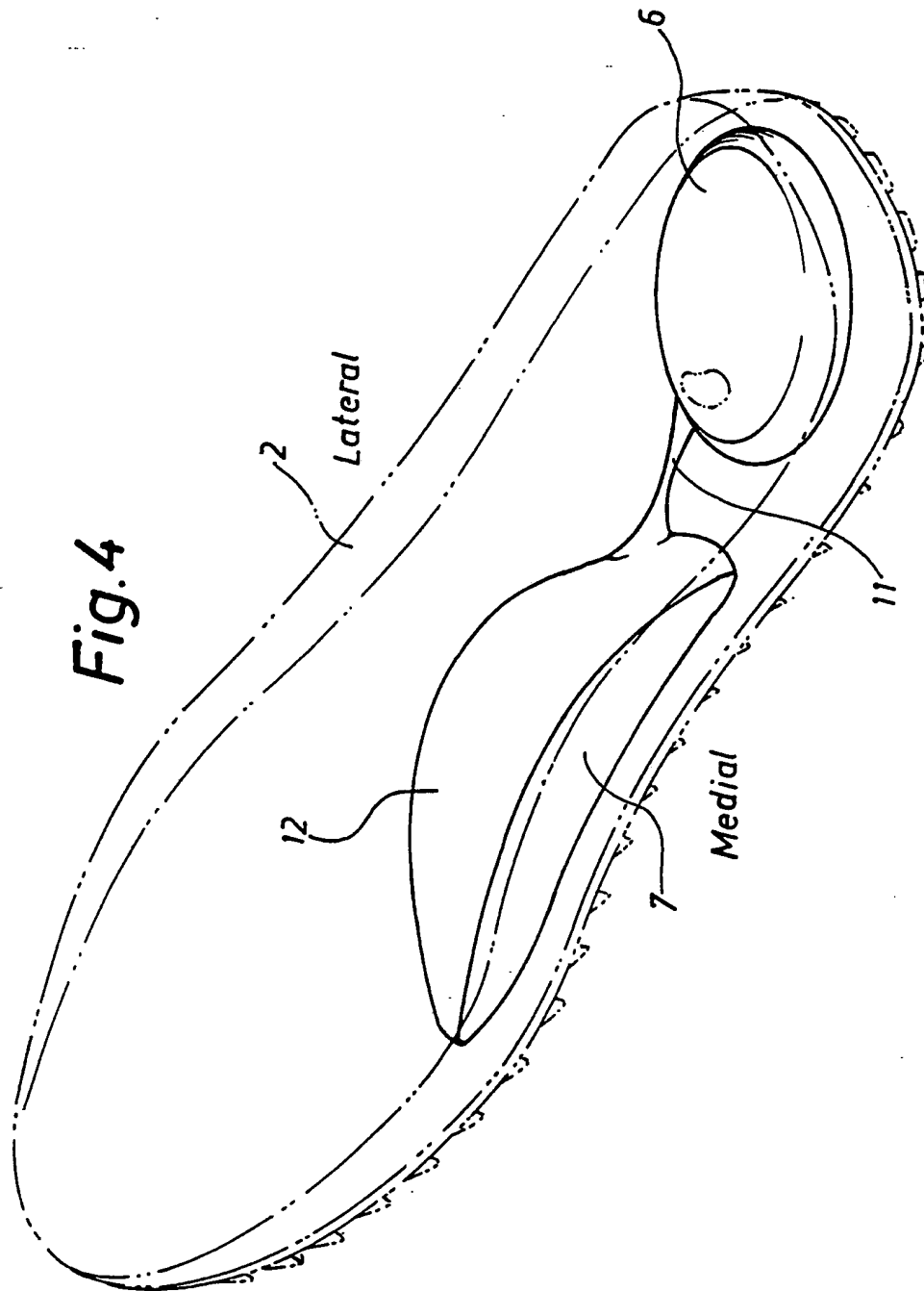
35

2/3

Fig. 2



3/3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 93/00239

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: A43B 13/18 // A61F 5/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: A43B, A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4358902 (COLE ET AL), 16 November 1982 (16.11.82) --	1-7
Y	US, A, 4446634 (JOHNSON ET AL), 8 May 1984 (08.05.84) --	1-7
Y	US, A, 4458430 (PETERSON), 10 July 1984 (10.07.84) --	1-7
Y	US, A, 4577417 (COLE), 25 March 1986 (25.03.86) --	1-7

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

23 June 1993

Date of mailing of the international search report

28 -06- 1993

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

Sune Söderling
Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 93/00239

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 1544547 (G.S. BARKER), 7 July 1925 (07.07.25) --	1-7
Y	US, A, 1605985 (K.J. RASMUSSEN), 9 November 1926 (09.11.26) -- -----	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

28/05/93

International application No.

PCT/SE 93/00239

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4358902	16/11/82	CA-A- 1143938 GB-A- 2073006 JP-A- 56139702	05/04/83 14/10/81 31/10/81
US-A- 4446634	08/05/84	NONE	
US-A- 4458430	10/07/84	DE-A- 3277831 EP-A,B- 0062622 SE-T3- 0062622	28/01/88 13/10/82
US-A- 4577417	25/03/86	CA-A- 1230225 EP-A,B- 0160880 SE-T3- 0160880	15/12/87 13/11/85
US-A- 1544547	07/07/25	NONE	
US-A- 1605985	09/11/26	NONE	